9. The ITB document on B5-3 indicates the seismic load is per geotechnical report. Please provide site classification basis and spectral response coefficients basis.

See Below

APPENDIX A

KANSAS CITY DISTRICT STRUCTURAL DESIGN CONTROLLING CRITERIA (SDCC)

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1. GENERAL.

1.1 *Purpose and Scope*.

Design will be completed in accordance with the criteria and instruction documents furnished for this project. A structural controlling criteria listing is provided below, however, the design engineer shall be responsible for incorporation of all applicable information.

1.2 *Minimum Requirements*.

The criteria established herein will be used as the minimum standards for structural loading and design. If a local code, which also must be followed for design of the building, is more stringent for a particular criterion, the local code may be used as the minimum requirement for that criterion.

1.3 *Applicability*.

This structural design controlling criteria is applicable to all projects within the Kansas City District military jurisdiction, or as stated otherwise.

2. REFERENCES.

The following are referenced documents within this controlling criteria and does not constitute a complete list of required design reference material. Note that US Army Corps of Engineers TI publications, Unified Facilities Guide Specifications (UFGS), and other select Corps of Engineers publications are available in electronic format via the TECHINFO internet site **http://www.hnd.usace.army.mil/techinfo**/.

Information on other US Army Corps of Engineers publications that are not available in electronic format can be found at **http://www.usace.army.mil/inet/usace-docs**/.

U.S. Army Corps of Engineers Technical Instructions

UFC 3-310-01 Load Assumptions for Buildings (Jun 2000)
TI 809-02 Structural Design Criteria for Buildings (Sep 1999)
TI 809-04 Seismic Design For Buildings (Jan 1999)
TI 809-07 Design of Cold-Formed Load Bearing Steel Systems and Masonry Veneer/Steel Stud Walls (Nov 1998)
TI 809-29 Structural Considerations for Metal Roofing (Aug 1999)
TI 809-30 Metal Building Systems (Aug 1998)
TI 818-02 Design of Deep Foundations (Aug 1998)

U.S. Army Technical Manuals/Air Force Manuals

TM 5-809-3/AFM 88-3, Ch.3/NAVFAC DM-2.9 Masonry Structural Design for Buildings (Oct 1992)
TM 5-809-6/AFM 88-3, Ch.6 Structural Design Criteria for Structures Other than Buildings (Dec 1991).CENWK-EC-DS SDCC - Version 3.3
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TM 5-809-12/AFM 88-3, Ch.12 Concrete Floor Slabs on Grade Subjected to Heavy Loads (Aug 1987)
TM 5-818-1/AFM 88-3, Ch.7 Soils and Geology Procedures for Foundation Design of Buildings and Other Structures (Except Hydraulic Structures) (Oct 1983)
TM 5-822-5/AFM 88-7, Ch.1 Pavement Design for Roads, Streets, Walks and Open Storage Areas (Incl C1) (Jun 1992)

Antiterrorism/ Force Protection (AT/FP) Criteria

AT/FP criteria is distributed as “For Official Use Only.” AT/FP criteria shall be obtained by requesting the latest documents from the Protective Design Center in Omaha.

Unified Facilities Guide Specifications (UFGS)

UFGS 03300 Cast-In-Place Structural Concrete
UFGS 04200 Masonry
UFGS 07416 Structural Standing Seam Metal Roof (SSSMR) System
UFGS 07530 Elastomeric Roofing (EPDM)
UFGS 13120 Standard Metal Building Systems
UFGS 13121 Metal Building Systems (Minor Requirements)

U.S. Army Corps of Engineers Design Guide

DG 1110-3-107 Design Guide for U.S. Army Reserve Facilities (Sep 1984)

U.S. Army Corps of Engineers Engineer Regulations

ER 1110-345-700 Design Analysis, Drawings, and Specifications (May 1997)

U.S. Army Corps of Engineers Engineer Manual

EM 1110-2-2502 Retaining and Flood Walls (Sep 1989)

American Concrete Institute Building Code

ACI 318 Requirements for Structural Concrete and Commentary (Latest Edition)

American Forest & Paper Association

ANSI/AF&PANDS-1997 “National Design Specification For Wood Construction”(1997 Edition)

American Institute of Steel Construction

AISC "Manual of Steel Construction –Allowable Stress Design" (Latest Edition)
AISC "Manual of Steel Construction –Load & Resistance Factor Design" (Latest Edition).CENWK-EC-DS SDCC - Version 3.3
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American Iron & Steel Institute

AISI “Cold Formed Steel Design Manual” (Latest Edition) American Iron & Steel Institute

American Society of Civil Engineers Standard

ASCE 7 ASCE Standard, Minimum Design Loads for Buildings and Other Structures (Latest Edition)

Federal Emergency Management Agency

FEMA 368 NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures

International Conference of Building Officials

UBC ”Uniform Building Code” 1997

IBC “International Building Code” (Latest Edition)

National Concrete Masonry Association

TEK Publication 12-2 “The Structural Role of Joint Reinforcement in Concrete Masonry”.

Steel Deck Institute

SDI Steel Roof Deck Design Manual (Steel Deck Institute Publication, current edition)

Steel Joist Institute

SJI Standard Specification, Load Tables and Weight Tables

3. SELECTION OF STRUCTURAL SYSTEM.

3.1 *Overal*l.

The overall structural system to be used will be based on the cost effectiveness of the system and will take into account both the superstructure and foundation. The comparison of competitive systems will also consider the cost factors related to the architectural, mechanical, electrical and other features that comprise the total building. The goals in the selection of a load resisting system are simplicity in the structural framing layout and symmetry in the structural system reaction to design loadings. The selections must consider the need for economy, function, and reliability. Structural systems selected must have deformation characteristics that are compatible with the architectural and other nonstructural building elements and features. Regular structure.

configuration, continuous and redundant load paths, and system ductility are attributes encouraged. These attributes are required of buildings constructed in high seismic areas.

3.2 *Coordinatio*n.

The structural engineer shall coordinate with the architect at the inception of the design, and throughout, so that the structural system layout can be properly coordinated with the building architecture to provide the most effective and efficient overall plan.

3.3 *Minimu*m.

The minimum structural system will be selected from TI 809-02, TI 809-04, and AT/FP criteria.

Conform to all applicable requirements, general and specific, found in TI 809-02, TI 809-04, and AT/FP criteria for the structural system selected.

4. LOADING CRITERIA.

4.1 *General Requirement*s.

4.1.1 For dead and live loads use ASCE 7.

4.1.2 For snow and wind loads use ASCE 7, except as modified by UFC 3-310-01. Use Category [___] to determine the importance factors and use wind exposure [___].

4.1.3 For seismic design use TI 809-04. Use seismic use group [___]. Use site class and site characteristic information as recommended in the geotechnical subsurface investigation report.

Use Table 5.2.2 from FEMA 368 for design coefficients and factors for basic seismic force resisting systems (R, Cd, ♣∧, etc.). Use the following spectral response coefficients for the locations listed below in Table 4-1. Otherwise, use the zip code for the project location and the USGS Zip Code earthquake ground motion hazard look-up page, which can be found on the internet world wide web address **http://geohazards.cr.usgs.gov/eq**/.

Table 4-1

Location	Ss	S1
Ft. Leavenworth, KS	0.13	0.06
Ft. Riley, KS	0.20	0.06
McConnell AFB, KS	0.14	0.06
Ft. LeonardWood, MO	0.27	0.13
Whiteman AFB, MO	0.13	0.08.

4.1.4 For combined loads, use ASCE 7 and TI 809-04 for load combinations that include seismic loads.

4.2 *Specific Requirement*s.

4.2.1 If wind loading on the main lateral force resisting system and/or the components and cladding members are greater than seismic loadings and thus are the controlling forces that are used for structural design, the structural seismic detailing requirements given in TI 809-04 must also be used. Both wind and seismic loading for components and cladding must be investigated to determine controlling forces regardless of controlling loads on the main force resisting system.

4.2.2 The tributary area "A" to be used in determining the exterior wind pressure coefficients for components and cladding shall be the actual loaded area of the structural element under consideration and not the entire area of the loading region in which the member resides.

However, for rectangular tributary areas, the width need not be assumed to be less than 1/3 of the
length of the area.
4.2.3 When determining the internal wind pressure coefficients for buildings, doors and windows
shall be assumed opened or closed as required to produce the coefficients that will produce the
greatest wind loadings, both inward and outward.
4.2.4 When the design roof snow or snow plus rain-on-snow loading is less than 20 pounds per
square foot (0.96 kPa), a roof live loading for construction and maintenance of 20 pounds per
square foot (0.96 kPa) shall be used for design of the structure. The minimum roof live load of 20
psf (0.96 kPa) is used in lieu of and not in addition to the snow or rain plus snow loading.
4.2.5 The maximum net inward and outward loads used in the design shall be indicated on the
Contract Drawings. The design engineer is responsible for calculating the wind loads based on
the applicable paragraph Loading Criteria, Specific Requirements. However, in calculating
component and cladding loading, whether or not the SSSMR is applied over a substrate, the
smallest acceptable internal pressure coefficient shall be as defined in ASCE 7. The component
and cladding loads shall be calculated based on the tributary area of a clip; maximum tributary
area of 10 square feet (1 square meter).
4.2.6 For loading on railings, use ASCE 7 except that the minimum load for one- and two-family
dwellings shall be 50 lb/ft (0.29 kN/m).
4.2.7 For electrically driven cranes, a design check shall be made assuming the live loading on
the crane is 2.75 times the rated loading. For this loading case, the allowable material
stresses.
may be 90% of the yield stresses. In lieu of this design check, an electric limit switch may be
used.
4.2.8 For electrically driven permanently installed cranes support use the impact percentages,
horizontal force percentages, and fatigue requirements in the Manual of Steel Construction
(AISC publication, current edition).

5. DESIGN CRITERIA.

5.1 *Foundation*s.
5.1.1 Comply with the applicable recommendations in the geotechnical subsurface investigation
report provided by CENWK-EC-GL.
5.1.2 Minimum footing depth for frost consideration shall be determined using UFC 3-310-01,
but not less than 3 feet (915mm). The bottom of all exterior footings shall also meet the recommendations in the geotechnical subsurface investigation report provided by CENWK-EC-GL.
5.1.3 Where control joints are required in concrete foundation walls, they shall be located where
control joints are required in CMU walls above the foundations. Control joints in concrete
foundations are not required at all control joints in CMU.
5.1.4 In all concrete foundation walls that directly support CMU walls, provide one additional
reinforcing bar longitudinally at the top of the concrete wall that is one size greater than the other
longitudinal reinforcement. This added bar shall be continuous through all control and construction joints. In all concrete walls with vertical mats of reinforcing in each face, provide
two additional bars at the top, one in each face.
5.1.5 When masonry veneer is used, the foundation stem wall shall be stepped to form a brick
ledge at least 8 inches (200mm) lower than the finished floor.
5.1.6 Basement walls (walls mostly below grade that are supported laterally by diaphragms at or
near the top and bottom) shall be designed using loadings based on at rest soil pressures. A
design check of basement walls shall be made using submerged earth pressure, the free water
surface at grade and surcharge loading if present. For this design check, the allowable stresses
for the wall materials may be increased to be 90% of the yield stresses or for strength design, a
overall load factor of 1.1 may be used.
5.1.7 Retaining walls subjected to hydraulic loadings such as flowing water, submergence, wave.

action, and spray, exposure to chemically contaminated atmosphere, and/or severe climatic
conditions, shall be designed using EM 1110-2-2502. Earth retaining walls not subjected to the
above mentioned conditions may be designed using TM 5-818-1. A design check of retaining

walls shall be made using assumed submerged active earth pressures, free water pressures all
around and surcharge loading if present. For this design check, factors of safety for overturning
and sliding shall be at least 1.2 and the allowable stresses for all wall materials may be increased
to be 90% of the yield stresses or for strength design, a overall load factor of 1.1 may be used.
5.1.8 For deep foundations, including concrete drilled pier foundations and, use TM 5-818-1,
and TI 818-02.
5.1.9 Loading docks, if present shall be designed as retaining walls using at-rest soil values.
5.1.10 Structural stoops shall be provided at exterior doorways directly adjacent to exterior
concrete slabs. Stoops should have foundations to frost depth and should be rigidly attached to
foundation walls.
5.2 *Concrete*.
5.2.1 For concrete design, except for slabs on grade subjected to heavy loads, use TI 809-02, TI
809-04, and ACI 318 with the TI's controlling over ACI in cases of conflict. TI 809-04 controls
over TI 809-02 in cases of conflict.
5.2.2 Do not use keys in horizontal and vertical concrete construction joints. Specify the use of
joints roughened to 1/4 inch (6mm) amplitude per ACI 318.
5.2.3 For concrete floor slabs-on-grade subjected to heavy moving loads, use TM 5-809-12.
5.2.4 For concrete floor slabs-on-grade subjected to post/rack loads, use Designing Floor Slabs
on Grade by Boyd C. Ringo and Robert B. Anderson, 1992, chapters 4 and 6 and "Slab Thickness Design for Industrial Concrete Floors on Grade" by Robert C. Packard, Portland
Cement Association, 1976 with the latter controlling in cases of conflict.
5.2.5 For exterior concrete slabs-on-grade subject to heavy moving loads, use TM 5-822-5.
5.3 *Masonry*.
5.3.1 For masonry design (CMU and/or brick), use TM 5-809-3, and TI 809-04 with TI 809-04
controlling in case of conflict..
5.3.2 All masonry design will be reinforced masonry. These walls shall be designed as reinforced masonry assuming simply supported vertical spans between diaphragms.
5.3.3 If exterior walls have a CMU wythe available due to economic or architectural reasons, the

CMU will be used as the vertical and main lateral force resisting systems in lieu of providing
steel frames along these walls.
5.3.4 Brick veneer with steel stud backup exterior wall systems shall strictly adhere to the criteria
and detailing requirements of TI 809-07.
5.3.5 In buildings with CMU structural and partition walls, all horizontal and vertical block
layout dimensions shall be based on coursing using an 8 inch module when using IP units for
design and a 200mm module when using hard metric design. This includes all dimensions for
openings as well as the total wall.
5.3.6 Steel columns shall not be embedded over all or part of their height in CMU or concrete
walls.
5.3.7 Single wythe CMU walls permanently exposed to weather shall be fully grouted.
5.3.8 The preferred method of construction of double wythe walls is that the wythes be brought
up together. The specification, section 04200 shall be edited to prohibit the use of adjustable
ties, to prohibit the construction of one wythe independent of the other, and to require that the
wythes be brought up together.
5.3.9 For double wythe walls, the maximum cavity width shall be 3.5 inches (89 mm) for ladder
type joint reinforcement at 16 inches (400 mm) vertical spacing. The maximum cavity width
shall be 5 inches (127 mm) for joint reinforcement vertical spacing of 8 inches (200 mm).
Reference National Concrete Masonry Association TEK Publication 12-2 “The Structural Role
of Joint Reinforcement in Concrete Masonry”.
5.3.10 In structural reinforced load bearing CMU walls, vertical reinforcing bars shall be hooked
into the top horizontal bond beam at the roof level with a standard ACI 90 degree hook for
resistance to roof uplift loads.
5.3.11 Structural CMU walls shall be placed in running bond pattern only. Stacked bond pattern
for structural walls is not permitted.
5.3.12 The use of thin brick veneer is not permitted..
5.4 *Structural Stee*l.
5.4.1 For structural steel design, use TI 809-04, TI 809-02, and the AISC Manual of Steel
Construction, current edition, with the TI’s controlling over AISC in cases of conflict. TI
809-04

controls over TI 809-02 in cases of conflict.
5.4.2 In buildings or other structures where the main vertical or lateral force resisting systems are structural steel, the main force member connections shall not be made by field welding; ie, there shall be no field welded moment connections, no field welded shear tabs, no field welded bracing connections, etc.
5.4.3 Structural steel columns or beams will not be given lateral support by the bottom chords or the bottom chords of extended open web or long span steel joists or joist girders.
5.4.4 In buildings where braced frames are used as all or part of the main lateral force resisting system, the stability of the structural system shall not depend on any single member or connection. Redundancy shall be provided either by using multiple bays of tension only X-bracing members or by using bracing members that are capable of both tension and compression if bracing is placed in a single bay. The lateral load resisting system shall comply with the redundancy requirements of TI 809-04.
5.5 *Metal Building System*s.
5.5.1 For metal building systems, previously referred to as pre-engineered metal buildings (PEMB), follow the guidance given in TI 809-30 and the criteria presented in UFGS 13120 and/or UFGS 13121 as applicable. The minimum size in plan of the building along with the required clear distance to the bottom of the structural steel should be shown on the contract plans along with any additional minimum clearance requirements. The minimum sizes of all foundation members, including thickness and reinforcing steel sizes and spacings, should be shown along with the minimum footing depth. The Contract Drawings shall show the vertical, horizontal, and moment loading used to compute the minimum footing sizes in a tabular form with the corresponding resultant footing sizes. The Contractor will be required by the specifications to provide the final design of the foundation, if the loading exceeds that shown on the drawings. All concrete floor slabs on grade will be designed using the applicable criteria contained in the section Design Criteria, Concrete above.
5.5.2 If the eave height of the metal building system exceeds 20 feet(6 meters), or the rigid frame span exceeds 60 feet(18 meters), or other considerations require, then hairpins shall not be used.

Other methods, such as foundation tie beams or at-rest pressures acting on the foundation elements, shall be used to provide resistance to the horizontal loads acting at the base of the
metal building system columns. Passive soil pressures will not be used to resist column thrusts.
unless sufficient supporting justification (including consideration of soil disturbance, moisture
conditions, freezing and thawing, and deflection) is provided. Not more than one-half the full
passive soil pressure will be used to resist horizontal thrust from columns.

5.5.3 The metal building system shall be structurally isolated from other structures (e.g. masonry
buildings or arms vaults) located therein.

5.5.4 To determine the minimum sizes of the foundation members, the loads of the metal building system columns shall be determined using the different loading combinations of the
latest version of ASCE 7 and a suitable computer program. The resultant footing sizes shall be
presented in tabular form in a footing schedule with the corresponding design loads on the
contract drawings.

5.5.5 Where the metal building system will be used to support lateral loads from non-structural
elements, such as the top of CMU firewalls, these loads shall be provided on the contract drawings.

5.5.6 The allowable methods for resisting lateral loads shall be cross-bracing, rigid frames, or
wind columns. All braces used in roofs and walls to transfer or resist load, such as wind loads,
seismic loads, and crane thrusts, shall be either standard hot rolled sections or rods. Adjustable
rods must be permanently locked in place after final adjustment. Cable bracing is not permitted
except for erection purposes.

5.5.7 The minimum required lateral force resisting system shall be shown on the roof framing
plan, to include the minimum number and location of cross braced bays.

5.5.8 Provide a typical base plate detail on the drawings and edit the specifications to assure
compliance with the following minimum base plate requirements:

All column base plates must be designed and fabricated with a minimum of (4) anchor rods.

Show the minimum edge distances from the anchor rod centerline to the edge of the base plate.

The base plate shall not bear on the slab-on-grade;

The base plate shall be grouted with non-shrink grout.

Show the minimum edge distance from the anchor rods to the concrete pedestal face. Anchor rods shall not be less than 3/4 inch (M20) in diameter and shall be confined.
by at least one #4 (#13) reinforcing bar.

5.5.9 When SSSMR is a component of a metal building system, the Unified Facilities Guide Specification (UFGS) section 07416 must be used and coordinated with CEGS section 13120 or 13121 as applicable.

5.6 *Steel Joists*.

5.6.1 For steel joist design, use Standard Specification, Load Tables and Weight Tables (Steel Joist Institute, current edition).

5.6.2 Open web and long span steel joists are designed as laterally supported simple beams under vertical uniform gravity loading. For any other condition, the joist manufacturer must be required to provide the certified design of the joist. The building designer will provide the desired joist depth and spacing along with the required loading diagrams for both upward and downward loadings. The designer will require the manufacturer to select and certify the joist design for the loads specified on the drawings.

5.6.3 Open web steel joists used on sloping roofs or floors that exceed a slope of 1/2 inch vertical on 12 inches horizontal (1:24) shall be designed by the manufacturer for that slope. The design shall include the effects of axial loads that result from load components acting parallel to the slope.

5.6.4 The bottom chord of open web steel joists shall not be extended to supporting members except as specifically shown on manufacturer's shop or erection drawings.

5.6.5 The bottom chord of open web steel joists shall not be used to support suspended loads.

5.6.6 Field welding to the bottom chord of open web steel joist is not permitted, except as expressly permitted in writing by the joist manufacturer.

5.7 *Decks, Diaphragms, and Light Gage Steel Members*.

5.7.1 For the general requirements for the design and detailing of diaphragms use TI 809-04.

5.7.2 Diaphragms shall have continuous chord members on all edges and shall have direct positive connection for transferring shear load to all members of the main lateral force resisting system.

5.7.3 For steel roof and floor deck design, use Steel Roof Deck Design Manual (Steel Deck
Institute Publication, current edition), TI 809-02 and TI 809-04 with TI's controlling
the.
diaphragm design over SDI and TI 809-04 controlling over TI 809-02 in cases of conflict.
5.7.4 All screw connections for diaphragms shall be No. 12 or larger. Weld connections of steel
deck shall use E60 electrodes.
5.7.5 For cold formed structural steel sheet members, strictly adhere to the design guidance
provisions of TI 809-07.
5.7.6 The use of expansion bolt anchors for connections between the elements of the main lateral
force resisting structural system is not permitted.
5.8 *Wood*.
5.8.1 For wood design and construction, excluding plywood, use National Design Specification
for Wood Construction and Design Values for Wood, TI 809-04, and TI 809-02 with the TI 809-
02 controlling over NFPA and TI 809-04 controlling over TI 809-02 in cases of conflict.
5.8.2 For plywood properties and design criteria, use current American Plywood Association
published brochures, TI 809-04 and TI 809-02 with the TI controlling for diaphragm flexibility
determination along with minimum nailing requirements for diaphragms.
5.8.3 Fire-retardant treated wood shall not be used for structural applications. This includes, but
is not limited to wood trusses, wood framing, and APA rated structural use panels (including
plywood). Reference UFGS 06100 for additional information.
5.8.4 The use of Oriented Strand Board (OSB) for non-vertical applications is not permitted. For
floor and roof sheathing, APA structural rated plywood sheathing only shall be used.
Specifically, for floors, use as a minimum, 23/32 inch (18mm) thickness APA rated STURD-I-FLOOR,
24 inch (600mm) on center span rating, Exposure 1, Tongue and Groove, glued and
nailed. In addition, all of the requirements of the APA “Code Plus Floor” shall be met. Ring- or
screw-shank nails shall be used.
5.9 *Roofing*.
5.9.1 Metal Roofing. Metal roofing systems shall conform to the guidance in TI 809-29, with
exceptions and revision contained herein.
5.9.1.1 Structural Standing Seam Metal Roof (SSSMR)System

5.9.1.1.1 Since there is a wide variety in roof system configurations, fastening systems, and.

accessories, excessive detailing of the roof system will be avoided. For conventionally engineered buildings, the designer will provide details to include all members below the hold-down clip, including subpurlins and their connections, attachment of wood blocking (if
used), and restrictions on the use of thermal barriers or blocks as required.
5.9.1.1.2 For conventionally engineered buildings, TI 809-02 requires the design engineer to
provide loading diagrams on the Contract Documents, including the dimensions of edge, eave,
ridge and corner zones. Loads are to be calculated in accordance with ASCE 7 using a maximum
tributary area of 10 square feet (1 square meter). The tributary is based on a maximum panel
width and maximum clip spacing. All tributary areas of 10 square feet (1 square meter) or less
have the same external pressure coefficient according to ASCE 7 and MBMA-01. The internal
pressure coefficient for conventionally engineered buildings and Metal Building Systems shall
be determined based on the combination of opened and closed doors and windows which produce the greatest wind loadings. The internal pressure coefficient shall be determined considering large openings, such as aircraft hanger doors, open, unless special provisions are
made to assure the openings will be closed at the time of high winds. The minimum internal
pressure coefficient per ASCE 7 for installations over open or solid substrates shall be used to
account for air infiltration and leakage at the eaves. For Metal Building Systems, select the basic
wind speed value from TI 809-01. The importance factor and exposure factors will be obtained
from ASCE 7. Loading diagrams for metal buildings systems are required to be submitted with
the shop drawings.
5.9.1.1.3 For conventionally engineered buildings both purlin and subpurlin design are the
responsibility of the designer. The designer will incorporate the criteria in the specifications
including the changes in the SPECIFICATIONS paragraph in the design of the framing members.
Typical roof sections showing the purlins or subpurlins, including minimum gauge, minimum

section properties, minimum connection requirements, bracing provisions for the flanges under
both positive and negative bending, and maximum allowable purlin or subpurlin spacing shall be
shown on the contract drawings.
5.9.1.1.4 For buildings utilizing a steel deck as a roof diaphragm, inverting the steel deck to
accommodate the subpurlins is not permitted.
5.9.1.1.5 Roof slopes less than 1½ inch on 12 (1:8) require mechanical seaming and the specifications must be revised to indicate this requirement.
5.9.1.1.6 When the SSSMR is a component of a metal building system, the UFGS section 07416 must be used and coordinated with UFGS section 13120 or 13121 as applicable.
5.9.1.2 Non-structural applications. A non-structural standing seam metal roof shall be applied
over a solid substrate. The designer is responsible for the design of the substrate.
Subpurlins are.
required if insulation is to be placed above the substrate and shall be shown on the Contract
Drawings. Attachment of clips through rigid insulation to structure is prohibited. If the substrate
is plywood, the design shall include a nailing pattern shown on the Contract Drawings. If the
substrate is a metal deck, the deck must be designed for the full wind load in accordance with the
provisions of Load Criteria, Specific Requirements. The metal deck shall be designed for concentrated loads and line loads in addition to the appropriate uniformly distributed load. Clips
or subpurlins shall be attached through the metal deck to the structure below with bolts or screws. If the clips or subpurlins are attached to the metal deck alone, then bolts (not less than ¼
inch (6mm) diameter with locking washers and nuts), blind screw-type expandable fasteners
(FAB-LOK fasteners as manufactured by Fabco Fastening Systems, or approved equal), or blind
(pop) rivets (9/32 inch (7mm) diameter, BULB-TITE, as manufactured by Olympic Fastening
Systems, Inc., or approved equal) must be used.
5.9.2 Elastomeric Roofing (EPDM)
5.9.2.1 EPDM roofing shall comply with the criteria UFGS 07530, ELASTOMERIC ROOFING
(EPDM). Only the adhesive bonded system will be used. The ballasted system is not permitted.
The adhesive bonded system will be used with the following additional requirements:
5.9.2.2 Require the manufacturer to provide a standard warranty for 10 years.

5.9.2.3 According to the guide specifications, insulation under adhered membrane must be attached to the substrate with mechanical fasteners or steep (Type III) insulation. The guide specifications also require that on steel decks, or any slope exceeding 1/2 inch per foot, the first layer of insulation shall be mechanically fastened. For multiple layers of insulation, the preferred practice is to mechanically fasten the bottom board and then adhere the upper boards to lower boards with steep asphalt or an approved adhesive. Mechanical fasteners must be capable of resisting the uplift roof pressures shown on the contract drawings, with appropriate factors of safety for the fasteners and substrate provided. The minimum factor of safety for fasteners is three.

5.9.2.4 Require the roofing manufacturer to furnish a certified wind uplift test, Factory Mutual, I-90 rating, for the roofing assembly. An I-90 rating -presently the highest Factory Mutual rating - is given when a load of 90 psf is reached and maintained for 1 minute. The minimum factor of safety for this system is two. This means that the membrane is considered suitable to sustain a maximum design load of 45 psf with a safety factor of two. There will be many cases where the uplift pressures shown on the wind uplift load diagram on the contract drawings will exceed 45 psf at corners and edges. If the design uplift values exceed 45 psf for the adhesive bonded system, the shortcomings of this type of roofing system shall be reported to the customer. If the customer considers it reasonable to accept the risk of failure and will be responsible to repair the damage as it occurs, then this roofing system may be used where design uplift exceeds 45 psf. If.

the customer decides that full resistance to design uplift above 45 psf must be provided, another roofing system shall be.

5.9.2.5 The contract drawings must include a wind uplift diagram based on criteria from TM 5-809-1/AFM 88-3, Chap. 1, for the entire roof, including the high pressure areas along the edges and corners. A load tributary area of 10 square feet or less should be used in determining wind

load coefficients.
5.9.2.6 Special attention must be given to the shop approval and evaluation of material to assure
that unacceptable materials and systems are not installed. The system shall comply in all respects
with the roof assemblies as described in the Factory Mutual Approval Guide. This includes
insulation type, fastener types and quantities, and adhesives.
5.9.3 Flat roofs shall have a secondary drainage system.
5.10 *Architectural, Mechanical, and Electrical Equipmen*t.
5.10.1 For anchorage and/or isolation requirements for architectural, mechanical and electrical
elements, use TI 809-04.
5.10.2 For underground storage tanks, the anchorage slabs and tank restraints shall be designed
assuming the tanks are empty and the free water surface is at the finished earth grade. The factor
of safety of the gravity loads over the buoyant forces shall be at least 1.5.
5.11 *Special Structures and Condition*s.
5.11.1 For structures other than buildings, use TM 5-809-6.
5.11.2 For Arms Vaults, use AR 190-11 “Physical Security of Arms, Ammunition, and Explosives” dated 12 Feb 1998.
5.11.3 For Tornado Shelters, use FEMA 361, Design and Construction Guidance for Community Shelters, Dated July 2000.
5.11.4 Rack storage design
5.11.4.1 The racks shall be designed in accordance with the latest version of the Uniform Building Code. The design and construction of the racks and rack components shall meet requirements to resist vertical and lateral seismic forces.
5.11.4.2 Minimum rack requirements for each different storage rack configuration shall be.

shown on the Contract Drawings. This includes the minimum post base plate size and the anchorage requirements. The A-E is responsible for assuring that the post load assumptions
made in designing the slab are not exceeded by the post loads of the actual rack configuration.
5.11.4.3 The specifications shall include the minimum acceptable material requirements, load
capacity, factor of safety, and submittal requirements for each type of rack storage unit required.

6. DESIGN ANALYSIS.

The Design Analysis Structural Chapter shall be prepared in accordance with ER-1110-345-700
and shall include, as a minimum, the following:
6.1 Structural System. The structural system shall be selected from the approved systems listed

in TI 809-02. A general description of the structural system for the building and/or truck loading
docks including seismic considerations should be given with reasons for selection of the system
used and including cost comparisons. Structural system examples include: (1) a building frame
system with load bearing and shear walls and interior steel columns supporting steel girders and
joists; (2) a moment resisting steel rigid frame system supporting steel beams and joists; (3) a
moment resisting concrete frame system with reinforced concrete beams, columns and pan joists;
(4) a bearing wall system with reinforced masonry exterior and interior vertical and lateral load
bearing walls with steel joists spanning between walls and supporting a flexible steel deck
diaphragm.

6.2 Roof and Floor System. General method of framing and type of deck including options.
Cost comparisons shall be furnished to justify system selected. Address the type, span to depth
ratios and classification of the diaphragm. Address features which impact the layout of the
structural framing, such as standing seam metal roofing.

6.3 Walls and Partitions. Describe composition and general range of thicknesses, seismic design
when used, method of providing lateral support for the partitions, and location of load bearing
and shear walls.

6.4 Foundation System. Foundation design data or assumptions and description of type of foundation system to be used for the buildings and truck loading docks.

6.5 Design Loads. Roof and floor live loads, wind and seismic lateral loads, and unusual dead
loads should be given. Truck loads for the design of the truck loading docks.

6.6 Design Data. A listing of material properties for all materials to be used in the project, including allowable soil properties (with source notation)..

6.7 Unusual Design Features. Those which might be controversial should be clearly presented in
such a manner that definite approval can be given.

6.8 Site Adaptation. When site adapting standard working drawings or designs used at other
locations, the data required herein should be limited to design changes resulting from loading,

climatic and soil conditions at the new site and/or updating for conformance to current criteria.
6.9 List criteria needed to complete final design.
6.10 Calculations done using computer programs or spreadsheets shall include sufficient documentation to verify input and output, accuracy of theory, and accuracy of computations.

7. CONTRACT DRAWINGS.

7.1 The drawings shall contain in the General Notes a list of the design loading criteria, a list of the strengths of the engineering materials used, the design soil values and any other data that would be pertinent to remodeling and/or future additions. Also, a description of the building structural system shall be given so that the construction contractor will know when the building is self supporting.
7.2 The detailing of structural steel framing, including connections, shall be complete. All weld types, weld sizes, bolting layouts, bolt sizes, connection plates and members sizes and locations and stiffener plates sizes and locations shall be shown. Elevations of steel frames used in the lateral load resisting system shall be shown on the contact drawings.
7.3 Elevations of all masonry walls showing all openings, lintels, bond beams, horizontal and vertical reinforcement and control joints shall be shown on the structural drawings, including horizontal and vertical dimensions of wall panels, openings, etc. Elevations shall indicate all portions of the masonry wall that are piers or columns as defined in TI 809-04, and indicate the required details. The minimum scale for masonry wall elevations shall be ¼ " = 1'-0" (1:50 for metric jobs).
7.4 All members, elements and connections that are a part of the main vertical and/or lateral force resisting system must be completely detailed.
7.5 Show locations of control joints for slab-on-grade floors. Show locations of brick expansion joints.
7.6 The required joist loading diagrams for both upward and downward loading, computed in accordance with the Loading Criteria General Requirements and Specific Requirements.

paragraphs, must be shown on the Contract Drawings.

7.7 See Section Design Criteria, Roofing in this appendix for standing seam metal roofing loading diagram requirements and minimum detailing requirements.

8. SPECIFICATIONS.

8.1 Proprietary materials, fabricated products or construction methods cannot be used. At least three manufacturers must be known before any product can be shown or specified.

8.2 Replace paragraph 1.2 Submittals, SD-02 Shop drawings given in the Corps of Engineer's Guide Specification (UFGS) Section 03200, Concrete Reinforcement, with the following: "Complete shop drawings shall be submitted. The shop drawings shall be prepared under the direct supervision of a licensed professional engineer. The shop drawings shall contain his seal and a statement certifying that they are in compliance with the specifications and contract drawings. The shop drawing shall include details of the bending and placing schedule of the steel reinforcement, together with bar schedules indicating the number, size, dimensions, and total length of various bars required. Bar lists and bending diagrams shall be checked for accuracy and completeness before the bars are fabricated. Details of typical supports for reinforcing steel shall be approved prior to placing any concrete. Shop drawings shall show all concrete dimensions, location of all reinforcement, elevations, reinforcing steel clearances, and the location of all construction joints shown on the drawings or proposed by the Contractor. The drawings shall show support details including types, sizes and spacing. Spacing between vertical reinforcing steel shall be shown on the wall elevations. The minimum scale used in the shop drawings shall be 3/8-inch to the foot (1:50). Reinforcement bending details shall conform to the requirements of ACI SP-66."

8.3 Concrete for buildings shall comply with the UFGS-03300 including changes through Notice 3 (February 1999) with the exception of subparagraph 1.3.4 Slump and paragraphs 1.4 PROPORTIONS OF MIX, 2.1 ADMIXTURES, 2.2 CEMENTITIOUS MATERIAL, 2.3 AGGREGATE, 3.3 BATCHING, MIXING AND TRANSPORTING CONCRETE, and 3.4 SAMPLING AND TESTING. Specific information for these paragraphs shall be obtained from CENWK-EC-GL for incorporation into the CEGS-03300 format. A Government mix design is required for the concrete used in all projects. Any project specific requirements which would necessitate changes in the mix design, examples of which include, but are not limited to drilled piers, industrial and other special application floor slabs, multicubical munition structures, and high strength concrete applications, shall be discussed with CENWK-EC-GL. It is the designer's

responsibility to bring the need for required changes in the mix design to the attention of both.

CENWK-EC-GL and CENWK-EC-DS. The results of these discussions, including any deviations from the preceding requirements shall be documented and included in the design
analysis.

8.4 Masonry shall comply with current version of UFGS-04200, but dated no earlier than July
1992 including changes through Notice 12 (Jun 1999). This specification includes mortar proportion requirements to reduce efflorescence. The specification, section 04200 shall be edited
to prohibit the use of adjustable ties, to prohibit the construction of one wythe independent of the
other, and to require that the wythes be brought up together in all seismic zones.

8.5 The standing seam roofing system shall comply with the current version of CEGS section
07416, but dated no earlier than October 1998 including changes through Notice 2 (Sep 1999),
with the exceptions noted below. Earlier versions of the specification are not to be used, if the
version of the specification you are editing does not match this number, notify CENWK.

8.5.1 Add the subparagraph 1.2.4 Manufacturer's Representative to read “A representative of the
SSSMR manufacturer, who is familiar with the design of the roof system supplied and experienced in the erection of roof systems similar in size to the one required under this contract,
shall be present at the job site during installation of the SSSMR to assure that the roof system
meets specified requirements. The manufacturer's representative shall be either an employee of
the manufacturer with at least two years experience in installing the roof system or an employee
of an independent installer that is certified by the SSSMR manufacturer to have two years of
experience in installing similar roof systems.”

8.5.2 Revise first sentence in subparagraph 1.3.5 Wind Loads to read, “The design uplift pressures for the roof system shall be [as indicated on the contract drawings.] [computed and
applied using a basic wind speed of _____ miles per hour (fastest mile), and importance factor of
_____, and exposure factor of _____, an internal pressure coefficient of _____, and a tributary
area of 10 square feet.].” The uplift pressures shall be computed by the design engineer and

shown on the drawings for conventional designed structures. For metal building systems, the
manufacturer must compute the uplift pressures using the parameters provided by the design
engineer.
8.5.3 Change the subparagraph 1.3.7 Framing Members Supporting the SSSMR System to read,
"[Structural cold-formed steel framing members and their connections, including minimum
required connection capacity shall be as shown on the contract drawings.] [Structural cold-formed steel framing members and their connections shall be designed in accordance with
AISI SG-673. Maximum deflections under applied dead and live load and/or wind load for
subpurlins shall not exceed 1/180 times the span length and shall be based on constraint conditions at the supports. Subpurlins shall be designed to span from structural member to
structural member. Attachment to a metal deck, if present, is permitted for lateral stability only..CENWK-EC-DS SDCC - Version 3.3
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Subpurlins must be adequately braced for both positive and negative bending. Subpurlins are
required at all clip locations in installations above a metal deck. Attaching clips through rigid
insulation to structure is prohibited.]"
8.5.4 From the subparagraph 1.3.8 Roof Panels Design, revise next to last sentence to read
"Deflections shall be based on panels being continuous across three or more supports, fastener
spacing, and the ability of the panel to rotate freely on the support."
8.5.5 Add the following to the end of subparagraph 1.3.9 Accessories and Their Fasteners, "The
design uplift force for the accessory connections and the factors of safety, shall be as required in
subparagraph 1.3.5 Wind Loads."
8.5.6 Add paragraph 1.4.1 to read as follows:
"1.4.1 Concealed Anchor Clip Connection to Building Structure
The tested capacity of fasteners used to connect the concealed anchor clips to [subpurlins]
[structural purlins] [metal roof deck] [plywood sheathing] shall be determined from tests supplied by the fastener manufacturer or an independent testing laboratory. Tests shall be performed on fasteners and supporting members that are made from the same materials and are
equal or less in size and thickness to the fasteners and supporting members used in the actual

roof installation. The maximum uplift loading used in the test shall be the design uplift force
multiplied by the factor of safety. The design uplift force and the factors of safety shall be as
required in subparagraph 1.3.5 Wind Loads."
8.5.7 Add paragraph 1.4.2 to read as follows:
"[1.4.2 Subpurlin Connection to Building Structure
The tested capacity of fasteners used to connect the subpurlins [to structural purlins] [through
metal roof deck to building structure] [to plywood sheathing] shall be determined from tests
supplied by the fastener manufacturer or an independent testing laboratory. Tests shall be
performed on fasteners and supporting members that are made from the same materials and are
equal or less in size and thickness to the fasteners and supporting members used in the actual
roof installation. The maximum uplift loading used in the test shall be the design uplift force
[given on the drawings for the roof area under consideration] multiplied by the factor of safety.
The factors of safety [and the design uplift force] shall be as required in subparagraph 1.3.5 Wind
Loads.]"
8.5.8 Change sub paragraph SD-03 Product Data to read,
"Design Analysis; [_____].
Design analysis signed by a Registered Professional Engineer, and submitted for approval prior to beginning of manufacture. The design analysis shall include, but not be limited to the following information:.

a. A list of the design loads.
b. Thermal movements that will result from the specified temperature range. The calculations shall be accompanied by details from the manufacturer that demonstrate how installed concealed anchor clips and other roof system devices will accommodate the required thermal movement.
c. Concentrated load and roof live load analysis.
[d. Subpurlin catalog cuts, section property information and sketches to indicate that the subpurlin geometry has been coordinated with the metal deck configuration and that the subpurlins will nest properly in the metal deck flutes.]
****
NOTE: The following submittal requirements apply to metal building systems only.
****
[d. Complete calculations of the support system [,including purlins and/or subpurlins designed in accordance with subparagraph: Framing Members].]
[e. Wind forces on various parts of the roof. Both positive and negative pressures shall be calculated based on the criteria in subparagraph: Design Conditions and

parameters in subparagraph: Wind Uplift Loads. The resultant wind uplift forces and dimensions of the edge and corner zones will be shown on an isometric view of the roof.]"

8.5.9 Add the following to the end of paragraph SD-04, Drawings to the end of the paragraph:

"The shop drawings shall also include the SSSMR component details that resulted from the design calculations and the wind uplift testing required herein. The shop drawings also shall show the locations and configuration of any thermal spacer blocks or barriers. Subpurlin layouts shall be shown [and the spacing must be coordinated with the metal deck configuration, lap locations, and sidelap configurations]."

8.5.10 Add the following items to the end of paragraph SD-06 Reports to read,

i. Fastener Test Report (Additional Requirement)- Manufacturer's test report or independent test laboratory report. Tests shall be performed on fasteners and supporting members that are made from the same materials and are equal or less in size and thickness to the fasteners and supporting members used in the actual roof installation..

j. Panel Finish Color (Additional Requirement)- Test results shall be submitted for all roofing panels showing the results of testing in accordance with the color finish tests specified in paragraphs 2.6.1 through 2.6.8.

8.5.11 Change paragraph SD-04 Samples to include submittal of external clamps or clips used by the manufacturer to increase the load capacity of the roof system. This paragraph must be coordinated with the user of the facility to assure that there is no architectural requirement to limit the use of external clamps.

"External attachments; [_____].
External attachment- two samples of every type of permanent external attachment either, clips or clamps, used in the tested system to increase the rated capacity of the roofing system."

8.5.12 Revise the second sentence of subparagraph 2.1.1 Steel Panels to read, "Uncoated panels shall be 0.024-inch (0.61 mm) thick minimum, except that areas of the roof subject to design wind uplift pressures of 60 psf (2.87 kPa) or greater shall have a minimum panel thickness of 0.030-inch (0.76 mm)."

8.5.13 Add the following to the end of subparagraph 2.3 ACCESSORIES "Thermal spacer blocks and other thermal barriers shall be submitted for approval."

8.5.14 Change the first sentence of subparagraph 2.4.1 Screws to read, “Screws for attaching
anchor devices shall be not less than No. 14 self-tapping type and not less than No. 12 if self-drilling and self-tapping type.”
8.5.15 Replace the first sentence of 2.5 SUBPURLINS to read, “ Cold formed subpurlins [,
when required by the system design,] shall be formed from steel sheet as standard with the
manufacturer. The uncoated thickness [shall be as shown on the contract drawings. The subpurlins shall meet the minimum properties shown on the contract drawings [, with the flange
configuration designed and coordinated to nest properly in the flutes of the metal deck.]] [may be
a minimum of 0.059-inches (1.50 mm) if bolts or structural blind fasteners are used for attachment of the concealed anchor clips to the subpurlins and attachment of the subpurlins to the
structure. If screws are used for either attachment, then the minimum uncoated thickness of the
subpurlin shall be 0.074-inches (1.85 mm).] Cold formed subpurlins shall have a minimum
tensile yield strength of 50,000 psi (345 MPa).”
8.5.16 Add to end of subparagraph 3.1.2 Subpurlins “Closer spacing may be required by the
roofing manufacturer to meet the roof uplift loads [shown on the contract drawings] [calculated.

and submitted with the shop drawings.]”
8.5.17 Replace the first sentence of subparagraph 3.1.4 Concealed Anchor Clips to read, “Roof
panels shall be fastened to framing members with concealed fastening clips or other concealed
devices. Clips shall be attached directly to the building structural system or to the subpurlins
with bolts or screws.”
8.5.18 Add to the end of subparagraph 3.1.4 Concealed Anchor Clips to read, “Closer spacing
may be required by the roofing manufacturer to meet the roof uplift pressures [shown on the
contract drawings] [calculated and submitted with the shop drawings.] Attachment of clips
through rigid insulation to structure is prohibited.”
8.5.19 Add the following to the end of subparagraph 3.2.1 Board Insulation with Blanket Insulation and to subparagraph Blanket Insulation 3.2.2, “Thermal blocks shall not be placed in
between the concealed anchor clips and the subpurlins or supporting structure.”
--End--